

Lockheed Martin Systems Integration – Owego  
1801 State Route 17C Owego, NY 13827-3998  
Telephone 607-751-2000



In Reply Refer To: 2008-ONRTEAM-0005

17 March 2009

NAVSEA Naval Surface Warfare Center  
110 Vernon Avenue  
Panama City, FL 32407

Attention: James S. Taylor, Program Officer

Subject: CDRL A004, Contract Data Requirements List (CDRL), Requirements  
Specification, Contract No. N00014-08-C-0142, Distribution Statement A

The enclosed data is submitted in accordance with the Contract Data Requirements List  
(CDRL):

CDRL Information:

-	CDRL:	A004
-	Data Item Title:	Demonstration Slides

Enclosed please find the subject CDRL submittal. Consistent with contract requirements, this submittal is being made in accordance with enclosure number 1 of the CDRL.

Any technical questions concerning this submittal should be directed to John Deopuria at (607) 751-3667 or via e-mail at [john.deopuria@lmco.com](mailto:john.deopuria@lmco.com).

Any other questions should be directed to the undersigned at (607) 751-2919, fax at (607) 751-3910 or via e-mail at [Bob.Rieg@lmco.com](mailto:Bob.Rieg@lmco.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Robert B. Rieg".

Robert B. Rieg  
Contracts

RBR/dlg

Enclosure: Demonstration Slides dated 16 March 2009

cc:	Mr. K. Wallace	DCMA/ACO	(Letter only)
	Ms. N. Kochinsky	Owego/0532	
	Mr. J. Deopuria	Owego/0902	
	Mr. R. Szczerba	Owego/0902	
	Director, Naval Research Lab	Washington, DC	
	DTIC	Ft. Belvoir, VA	

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**Demonstration Slides For**  
**Team-Based Execution Of Autonomous Missions (TEAM), Spiral 1**  
**CDRL A004**  
**Contract No: N00014-08-C-0142**  
**March 16, 2009**  
**Lockheed Martin Systems Integration**  
**Owego, New York**

**To:**  
**NAVSEA**  
**Naval Surface Warfare Center**  
**110 Vernon Avenue**  
**Panama City, FL 32407**

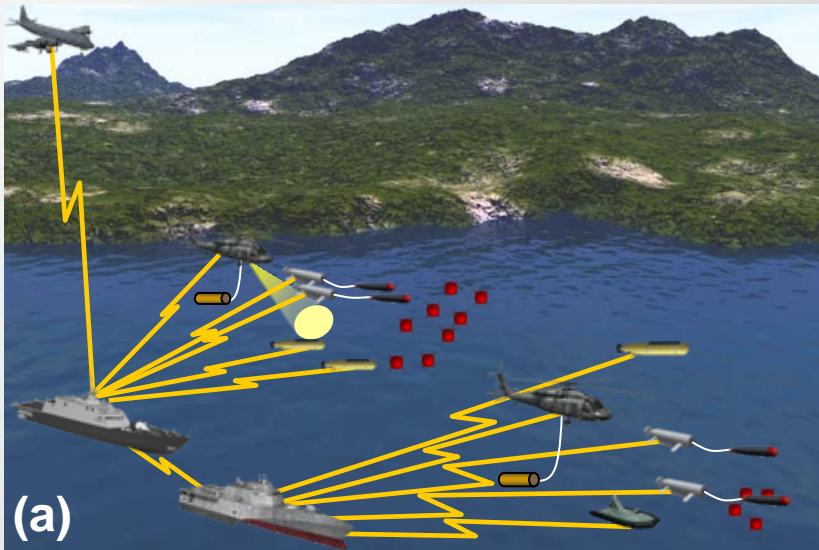


## MCM Systems for LCS Advanced Flight Mission Package

Team-based Execution of Autonomous Missions (TEAM)

**Spiral 1 – Demonstration**

Lockheed Martin Systems Integration – Owego



- **Current LCS Approach**
- **Vehicle-Centric C2**
  - Focus on “Control” of Individual Vehicles / Payloads
  - Mission Execution Coordination is Manually Intensive
  - Many Sequential Operations

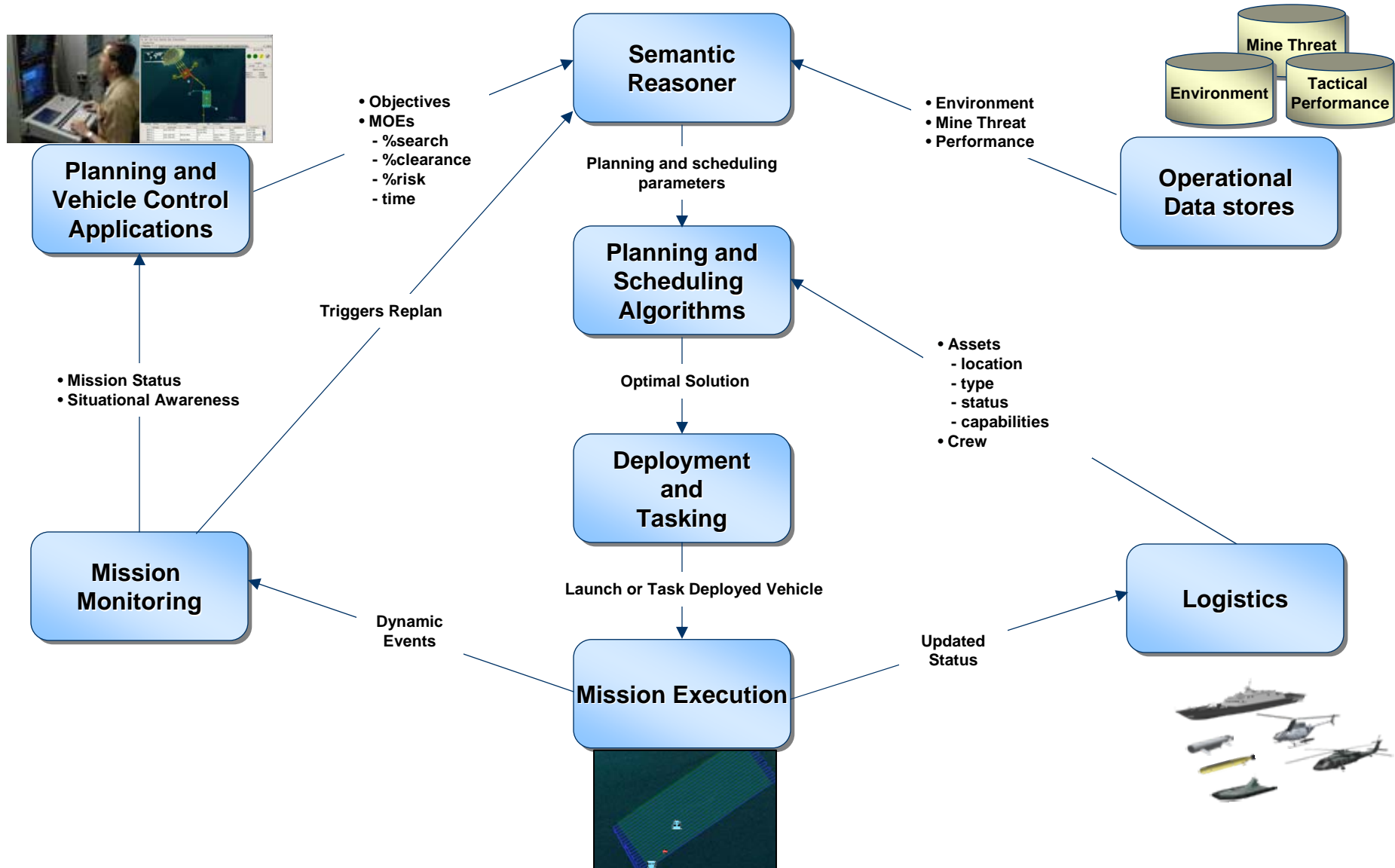


- **Proposed TEAM Approach**
- **Mission-Centric C2**
  - Focus on “Command” of Multi-Vehicle Teams
  - Allows Autonomous Mission Execution Coordination as Needed
  - Focus on Parallel Operations

**Optimization Across the Entire Mission Results in Reduced Workload and Increased Operational Effectiveness**



# Logical TEAM Representation





- **Programmatic**

- Show an intermediate snapshot of progress to date
- Preview of aspects of Spiral 2 Capstone Demo in Sept. 2009
- Framework for Spiral 2 and Phase II Capability Discussions

- **Operational**

- Multi-asset team-based MCM mission planning
- Integrated manned and unmanned vehicle team
- Integrated legacy planning systems (MEDAL, JMPS, etc.)
- Automating key mission aspects:
  - Tasking, Scheduling, & Route planning

- **Technical**

- Instantiation of Standards-Based SOA Infrastructure
- Integration of Multiple Legacy Components



## MH-60 Cockpit Sim

- Pilot
- Sensor Operator
- Out-the-window



## Video Wall

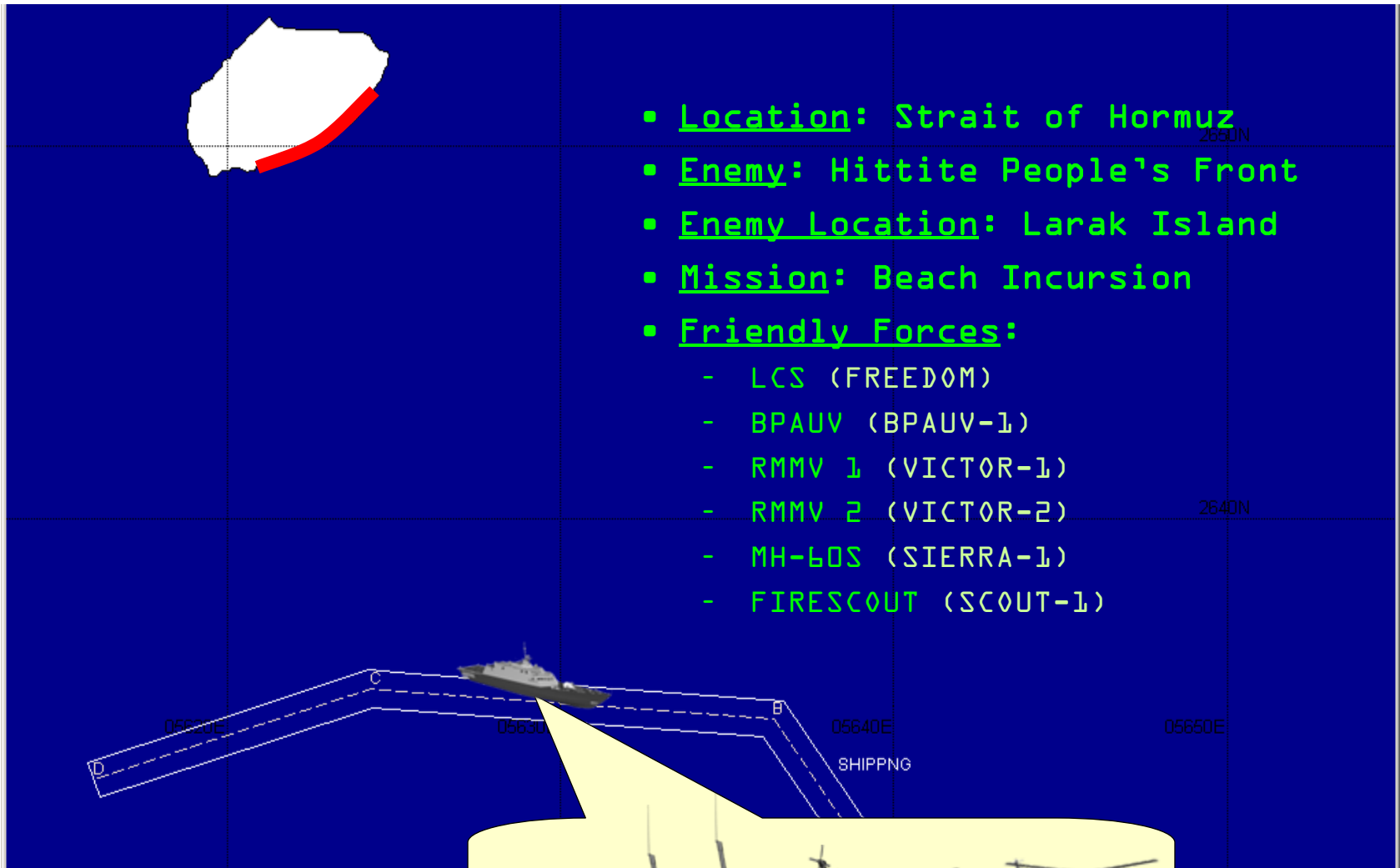
- TEAM Planning
- MEDAL
- JMPS
- Presentation

## MH-60S Display Cart

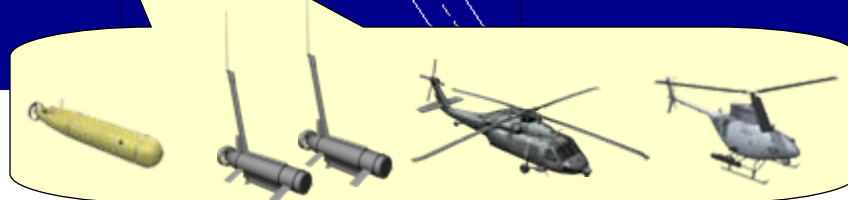
- Out-the-window  
Pilot mission and  
flight display
- MCM control and  
sensor display



# Mission Overview



- Location: Strait of Hormuz
- Enemy: Hittite People's Front
- Enemy Location: Larak Island
- Mission: Beach Incursion
- Friendly Forces:
  - LCS (FREEDOM)
  - BPAUV (BPAUV-1)
  - RMMV 1 (VICTOR-1)
  - RMMV 2 (VICTOR-2)
  - MH-60S (SIERRA-1)
  - FIRESOULT (SCOUT-1)





**BPAUV**



**RMS**



**AQS-20A**

**VTUAV**



**COBRA**

**MH60S**



**AQS-20A**



**ALMDS**

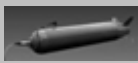


**AMNS**

**USSV**



**RAMICS**



**OASIS**

## MIW Additional Attributes

Mine hunting using off-board sensors against volume, bottom and near bottom mines

Mine identification using off-board sensors against bottom mines

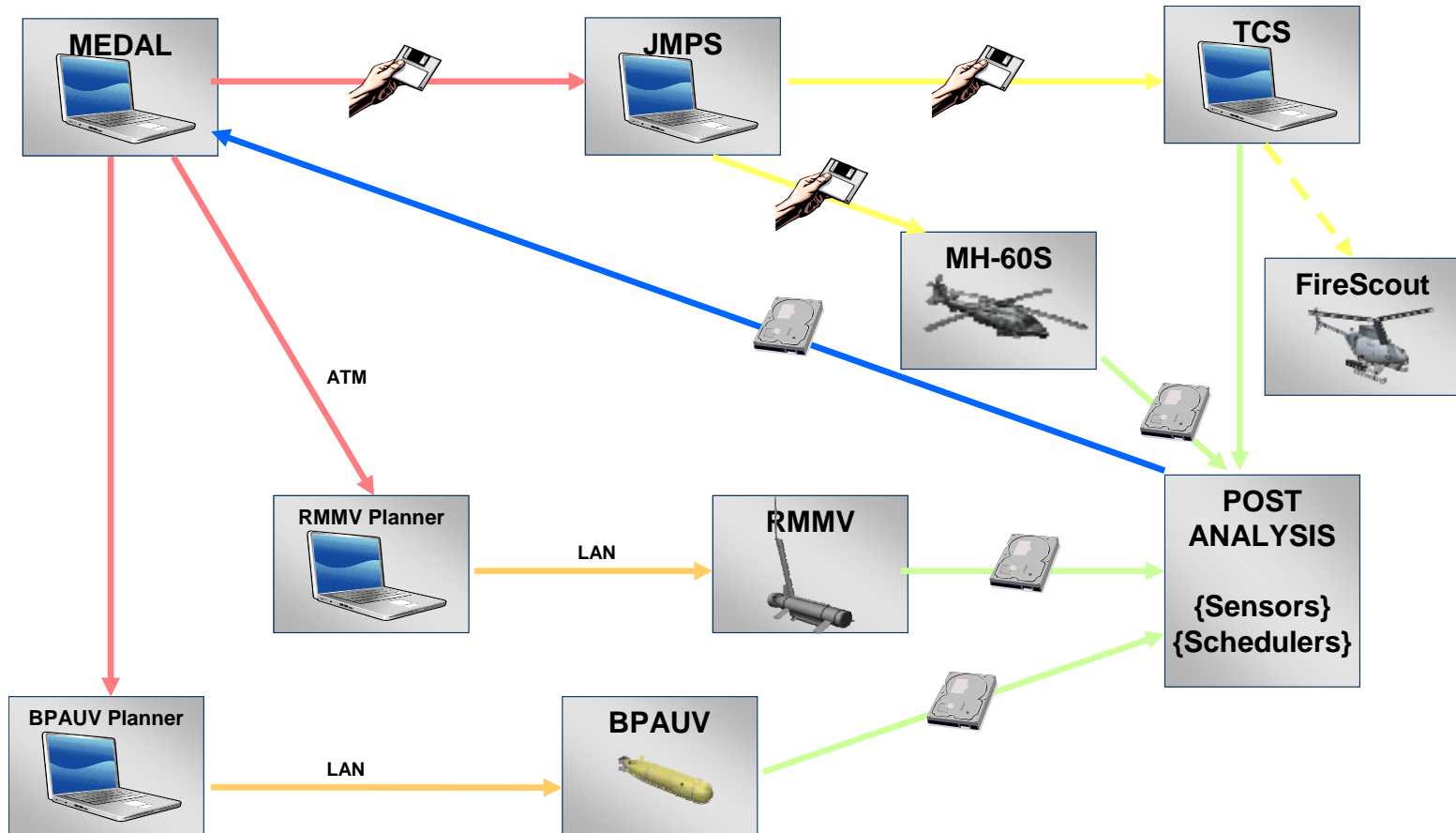
Mine hunting using off-board sensors against near surface and floating mines

Mine neutralization of volume, bottom and near bottom mines using off-board systems

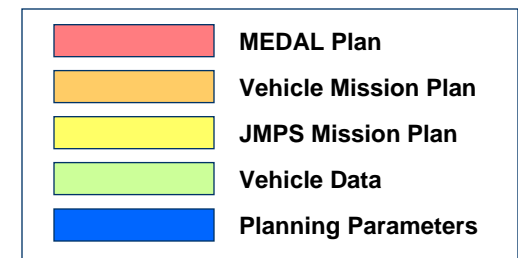
Mine neutralization of near surface and floating mines using off-board systems

Magnetic / acoustic influence minesweeping using off-board systems against magnetic / acoustic influence mines

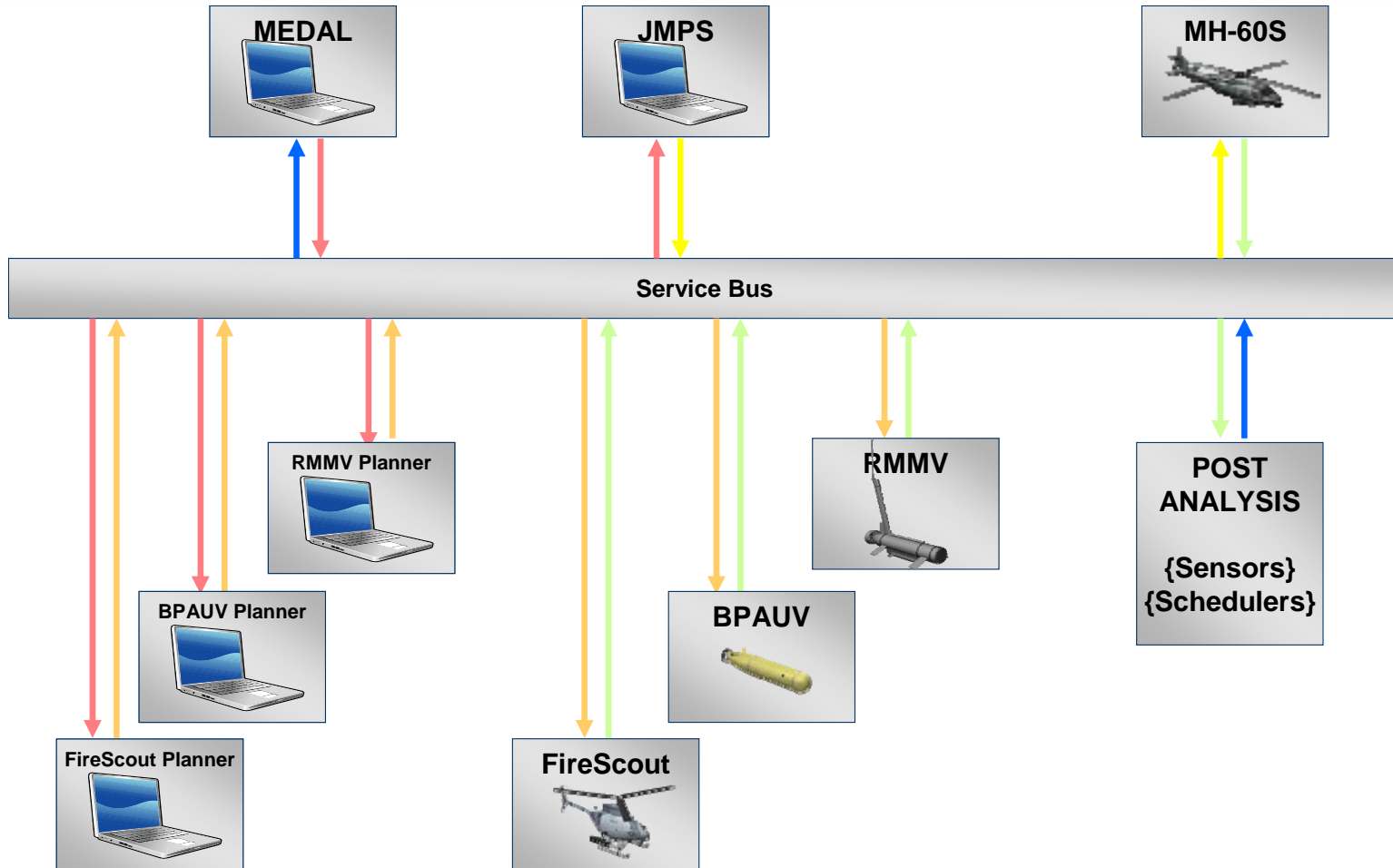
# Deploy Plan to Assets (Current Data Flow)



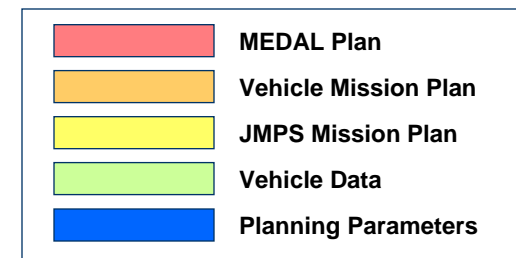
- Manually Intensive
- Highly and Diversely Skilled Operators
- Point-to-Point Interfaces Difficult to Scale



# Deploy Plan to Assets (TEAM Data Flow)



- Automated Planning and Decision Aids
- Common Tools for Common Skill Set
- Interface-Managed Flow Control Eases Scaling and Flexibility





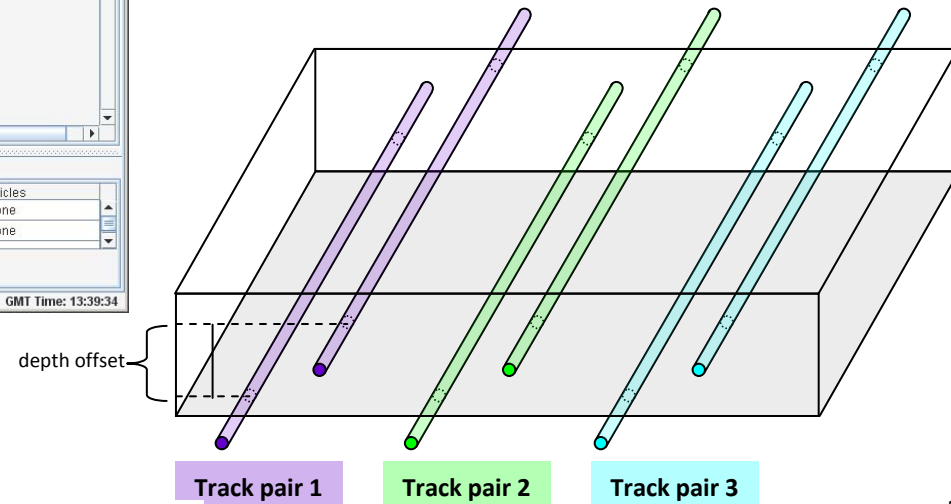
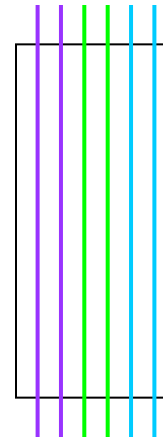
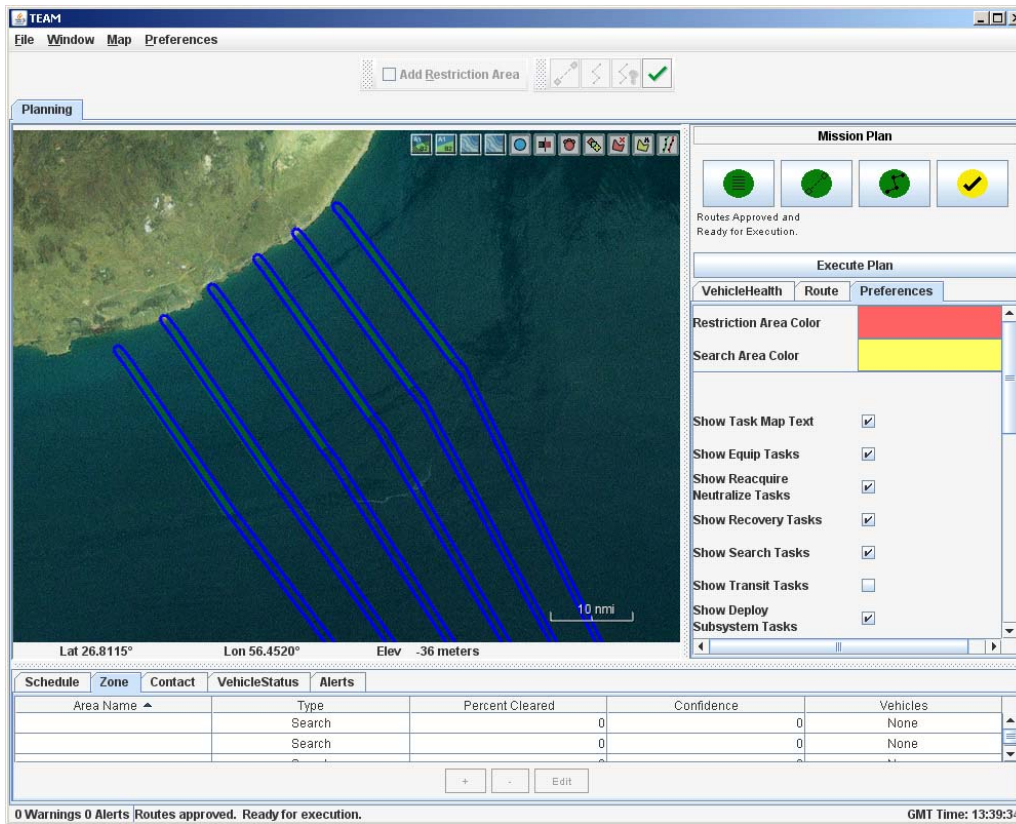
- **BPAUV Environmental Survey**
- **Update MEDAL Objectives**
- **TEAM Spiral 1 Display Features**
- **Plan TEAM Assets for Entire Mission**
- **Plan TEAM Assets for Single Region**
- **Deploy Plan to Assets**
- **Mission Execution – Search**
- **Plan Neutralization Mission**
- **TEAM Alternate Scheduler**
- **TEAM More Complicated Plans**



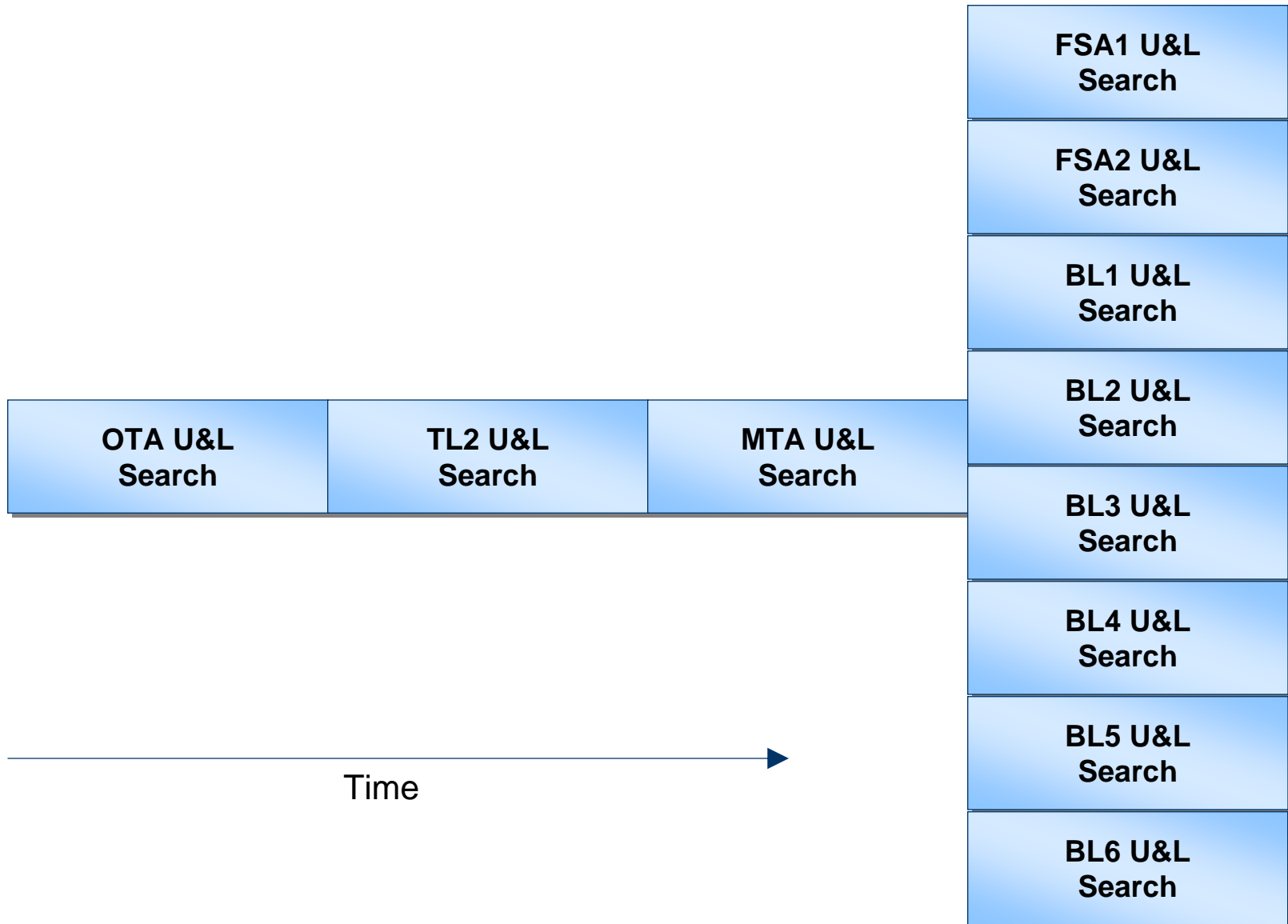
# BPAUV Environmental Survey



- The BPAUV asset is scheduled to scan the boat lanes.
- The BPAUV tasks are executed prior to the planning and execution of MCM search tasks



# Update MEDAL Objectives





## Map features

- Zoom, pan, scale
- Lat/Long
- Map layers
  - Digital Nautical Chart (DNC)
  - Bathymetry data
  - Bottom type
  - Restore default layers
  - Legend

## Tabular Data

- Schedule
- Zones
- Contacts
- Asset Status
- Alerts

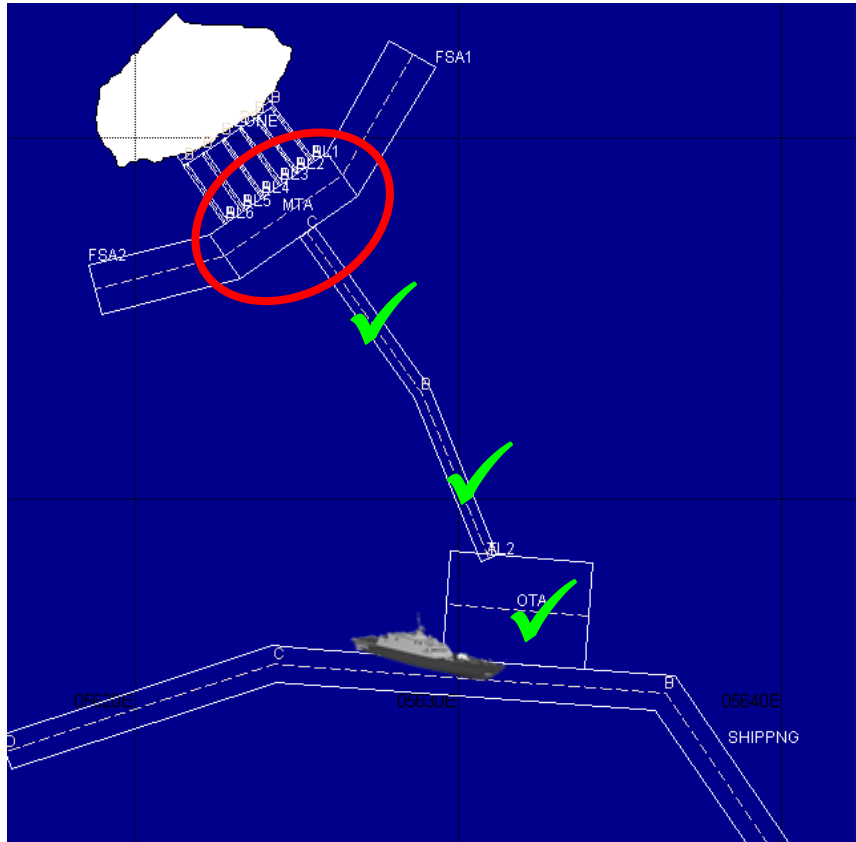
## Plan Details

- Vehicle health
- Route
- Preferences



- **Import MEDAL objectives**
- **Zone details**
- **Callouts for MTA and boat lanes**
- **Schedule and plan mission**
- **View schedule**
  - Tabular data
  - Gantt chart
- **Display layers**
  - All scheduled routes
  - Declutter tasks
  - Declutter all routes on map
  - Use preferences to display plans for single asset

# Plan TEAM Assets for Single Region



- Load only MTA objective
- LCS remains in OTA
- Generate schedule and plan
- Detailed map features
  - Ingress / egress
  - Turns
  - Tracks
  - Track spacing
  - Track extensions





## **Search mission execution in progress:**

- **MH-60S with ALMDS in MTA**
- **RMMV with AQS-20 at start of first track of MTA**
- **View false detects on ALMDS sensor display**
- **RMMV detects a contact**
- **View contact details**



- **Load neutralization objective**
- **Generate schedule and plan**
- **Plan features**
  - Ingress / egress
  - Contact to reacquire



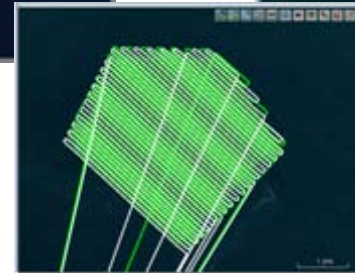
Original TEAM scheduling algorithm plan

- **Alternate Scheduler**

- Daniel H. Wagner Associates, Inc.
  - MVMP
  - Developed under SBIR
- MTA only
- Original assets:
  - MH-60S
  - 2 RMMVs)

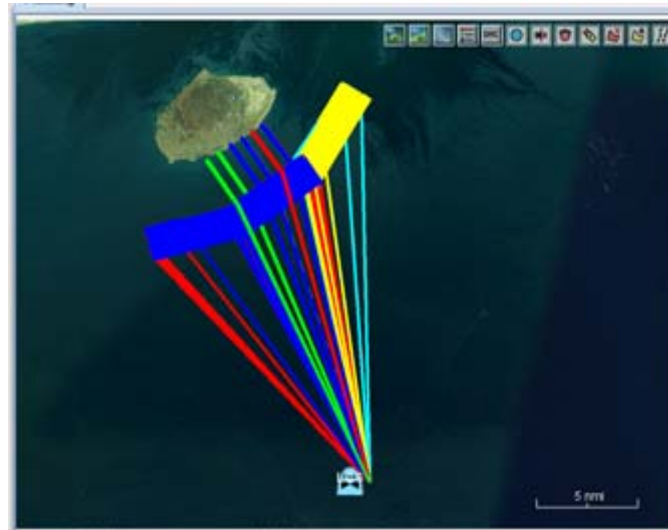
- **Alternate Geometries**

- Non-rectangular regions
- More areas
- Transit loop



- **Additional Assets**

- Areas:
  - MTA
  - 2 FSA regions
- Assets
  - 3 MH-60S
  - 6 RMMVs



## Performance Data

All Areas	18.8 sec
MTA	2.4 sec
Alt Geom	18.1 sec
Wagner All Areas	21.3 sec
Wagner MTA	2.9 sec
Wagner Alt Geom	20.7 sec



- ✓ **Infrastructure Foundation**
- ✓ **Built on that Foundation with Automated Manned-Unmanned, Team-Based Planning**
- ✓ **Built on that with a Consistent, Unified Operator Interface to Facilitate Operator-System Interaction**

## **Beyond that**

- Further Built Up that Structure by Interoperation with
  - Legacy Systems
  - Existing Internal Investment Systems
  - System Developed by a Third Party under a Separate Effort
- Demonstrated the Structure in an Execution Vignette

**Ready to Perform on Spiral 2 and Phase 2**